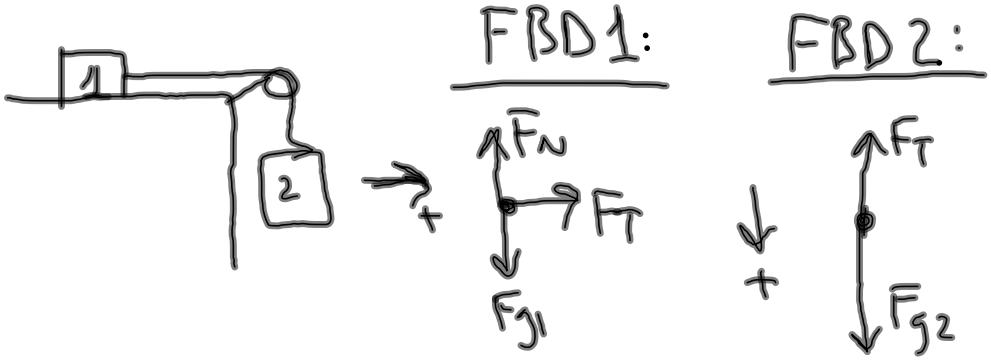
Choose one of Newton's Laws that best explains each situation or statement.

- The reason why the ground doesn't let you fall through.
- The reason you rock to the left when you make a right turn in a car.
- Wear your seatbelt so you won't get thrown out of the vehicle!
- Pets have a hard time walking on slick kitchen floors.
- That funny sensation when an elevator going up comes to a stop.
- A cannon on wheels will roll backward when it is fired.
- The same cannon (see last problem) will accelerate more slowly than the cannon ball after fired.
- I'd rather be in a wreck with a car than a Mack truck!
- A space shuttle in space will only need a small boost to reach a planet; no more gas is needed after the boost!
- The reason the space shuttle can go upward when launching.

A block of mass 18.8 kg is on a frictionless horizontal surface and is attached to a block of mass 3.5 kg that is hanging by means of a rope passed over a pulley. Find the acceleration of the mass on the table.



$$\Sigma F_1 = m_1 a \qquad \Sigma F_2 = m_2 a$$

$$F_T = m_1 a \qquad F_{g2} - F_T = m_2 a$$

$$F_{g2} = m_2 g$$

$$m_2 g - m_1 a = m_2 a$$

$$a = \frac{m_2 g}{m_1 + m_2}$$

$$= 1.54 \text{ m/s}^2$$

Pulley I problem → block table/block hanging
(1) (2)

$a = \frac{m_2 a_g}{m_1 + m_2}$ w/o friction

Eqns. → $\Sigma \bar{F} = m\bar{a}$ $F_g = ma_g$

$F_f = \mu F_N$

Pulley II problems → both masses hanging

$a = \frac{a_g(m_1 - m_2)}{(m_1 + m_2)}$

1 → left block

2 → right block

$m_1 > m_2$

Pulley problems → accelerations are equal
F_T are equal

Tug-of-war → force equal

a) You are standing on a scale in an elevator, and it is not accelerating. Is your mass changing? Does the force that the scale reads change?
b) Now the elevator is accelerating downwards. How does the force that the scale reads change?
c) Finally, the elevator is accelerating upwards. How does the force that the scale reads change?

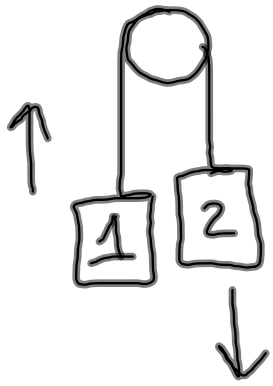
a) Mass doesn't change.

Force does NOT change.

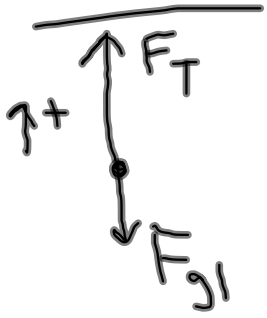
b) The force on the scale would be less.

c) The force on the scale would be more.

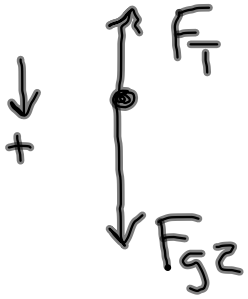
Two masses are hanging by a rope passed over a pulley. The mass on the left is 217 kg, and the mass on the right is 439 kg. What is the acceleration of the block on the right?



FBD 1:



FBD 2:



$$\Sigma F_1 = m_1 a \qquad \Sigma F_2 = m_2 a$$

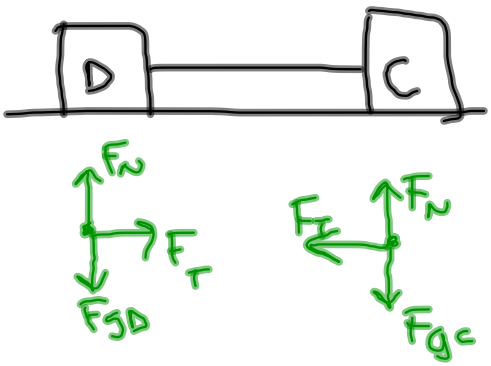
$$F_T - F_{g1} = m_1 a \qquad F_{g2} - F_T = m_2 a$$

algebraic steps

$$a = \frac{m_2 a_g - m_1 a_g}{m_1 + m_2}$$

$$= 3.32\ m/s^2$$

In a game of tug-o-war on a frictionless surface, a 120.0 N dog pulls on a 65.5 N cat, making the cat accelerate at 1.42 m/s/s. What is the acceleration of the dog?



$$m_D = \frac{F_D}{a_g} = 12.24\ kg$$

$$m_C = \frac{F_C}{a_g} = 6.63\ kg$$

$$\Sigma F_C = m_C a_C$$

$$= 9.41\ N$$ * this force also acts on the dog

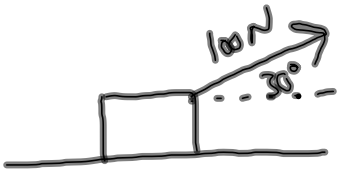
$$\Sigma F_D = m_D a_D$$

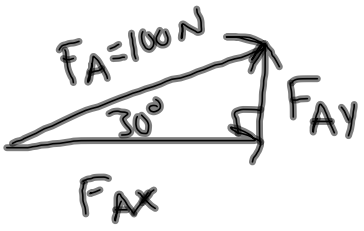
$$a_D = \frac{\Sigma F_D}{m_D}$$

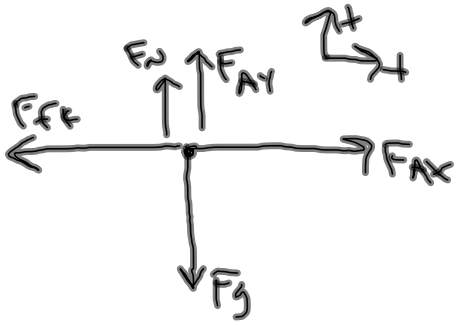
$$= 0.774\ m/s^2$$

Forces Review and Practice Problems 3.14.12 CP Physics

A block with mass 20 kg is pulled along a horizontal surface at constant velocity with a force of 100 N at an angle of 30 degrees above the horizontal. Find the coefficient of kinetic friction.







$F_{Ax} = F_A \cos(30°) = 86.6\,N$

$F_{Ay} = F_A \sin(30°) = 50\,N$

$F_{fk} = \mu_k F_N$

$\mu_k = \dfrac{F_{fk}}{F_N}$

$= \dfrac{86.6\,N}{146\,N}$

$= 0.593$

Constant Velocity

$\Sigma F_x = \emptyset$

$F_{Ax} - F_{fk} = \emptyset$

$F_{fk} = F_{Ax} = 86.6\,N$

$\Sigma F_y = \emptyset$

$F_N + F_{Ay} - F_g = \emptyset$

$F_N = F_g - F_{Ay}$

$= 196\,N - 50\,N$

$= 146\,N$

A 6.5 kg cat is in a 105 kg elevator. What force on the elevator cable would be needed to raise the cat/elevator pair upwards with an acceleration of 3.72 m/s/s upwards?